DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Life Cycle Assessment of Pavement

Developing a framework to evaluate the impact of the pavement life cycle on the environment

Pavement

JUNE 2013

Project Title:
Studies to Support Global Climate Change Initiative

Task Number: 1897
Completion Date: October 31, 2011

This project developed guidelines and resolved implementation issues for using the Life Cycle Assessment methodology to make better informed decisions regarding changes to the pavement process to reduce emissions and lessen environmental impacts.

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WHAT WAS THE NEED?

It is estimated that about $160 billion and 320 million metric tons of raw materials are used annually in construction and maintenance activities related to the U.S. highway system. Current pavement operations consume large amounts of energy and natural resources and emit significant quantities of greenhouse gases (GHGs), criteria air pollutants, and water pollutants. A highway's pavement condition, such as roughness, also affects vehicle emissions. To address the harm caused by these emissions as well as the increasing costs of resources, efforts are underway to mitigate the environmental impact. However, when a systemic process is changed to reduce its environmental impact, the changes can unintentionally result in greater harm if only certain phases of the system are targeted without looking at the impact on the entire life cycle.

Life cycle assessment (LCA) is a comprehensive approach based on International Organization for Standardization (ISO) standards to evaluate the consequences of changes across a product's life cycle, from raw material selection to the end of life. For pavement, this cycle includes the material production, construction, use, maintenance and rehabilitation, and end-of-life phases. Performing an LCA on pavement is much more complex than for most other industrial products. Pavement LCA practitioners lack a well-tested method and comprehensive body of knowledge for performing these assessments and are also relying on different data sources. This study provides some coherence to the development of applying LCA to pavement to improve decision-making.

Caltrans improves mobility across California by performing applied research, developing innovations, and implementing solutions.

WHAT WAS OUR GOAL?

To support California's Global Climate Change Initiative, the goal was to enhance the LCA methodology to evaluate the environmental impact of the pavement life cycle from cradle to grave and to use the results to provide recommendations for changes to production, design, construction, maintenance, and rehabilitation practices to reduce carbon emissions.

WHAT DID WE DO?

Caltrans worked together with the University of California Pavement Research Center (UCPRC), the Miriam project (a consortium of Caltrans, UCPRC, and eight national highway research laboratories in Europe), and the University of California Institute of Transportation Studies at Davis and Berkeley, to recommend common practices for conducting LCA for pavements. This first stage of the research developed an LCA framework that addresses ISO standards, system boundaries, and documentation requirements. The team established guidelines for how to apply LCA to pavement and formulated approaches that are relevant to California. They also created simple models for use within the LCA framework to simulate greenhouse gas emissions and energy use on the state highway network as a function of state pavement management practices.

In May 2010, a workshop was held to discuss the initial draft of the guidelines and to address questions regarding the LCA methodology and the application of the results. Workshop attendees included academics, staff from the Federal Highway Administration (FHWA), Caltrans, and local governments, materials producers, contractors, and LCA experts from other fields.

WHAT WAS THE OUTCOME?

The *UCPRC Pavement LCA Guidelines* describes the framework, system boundaries, and standard assumptions for pavement LCA practitioners. It includes recommended models and data sources for each phase of the life cycle and level. The Pavement LCA Checklist provides an overview of the various components that pavement LCA practitioners can use to compare in terms of completeness, assumptions, system boundaries, data, models, and possible alternatives.

WHAT IS THE BENEFIT?

Establishing LCA guidelines that apply to the specifics of the pavement life cycle provides a framework in which to assess changes and evaluate their impact on energy use and GHG emissions. The LCA methodology helps project designers and planners make more-informed decisions and compare alternative strategies for pavement treatments. The guidelines produced by this project are now being used by LCA practitioners around the world. The FHWA has also adopted the guidelines to address pavement sustainability.

LEARN MORE

To view the guidelines:
www.ucprc.ucdavis.edu/PDF/UCPRC-TM-2010-03.pdf